Construction Report
for
Iowa DOT Project HR-527
Included in
Iowa DOT Construction Project - Shelby FR-59-4(22)--2G-83

Federal Highway Administration
Experimental Project IA 86-02

CRACKING AND SEATING PCC PAVEMENT PRIOR TO RESURFACING

by
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Research Engineer
515-239-1447

Iowa Department of Transportation
Office of Materials
Ames, Iowa 50010

December 1986

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DISCLAIMER

INTRODUCTION

Construction of an excellent network of primary highways across the State of Iowa has essentially been completed. The major task facing the Iowa Department of Transportation today is the maintenance and rehabilitation of that network. The most commonly utilized rehabilitation practice is asphalt concrete resurfacing. This practice will normally provide a good driving surface for at least 10 additional years. The major problem with asphalt concrete resurfacing is the reflection cracking from underlying cracks and joints in the portland cement concrete (PCC) pavement. Deterioration and spalling occur at these reflection cracks and are the limiting factor of the effective life of the asphalt concrete resurfacing.

In recent years, there has been renewed interest in cracking the underlying PCC pavement prior to the asphalt concrete resurfacing. This allows the thermal movement to take place at many close interval cracks and alleviates the necessity of all of the thermal movement occurring at the joints of the underlying PCC pavement. The states of Minnesota and Kentucky have reported success in reducing or at least delaying the number of reflective cracks by using cracking and seating prior to asphalt resurfacing. The Minnesota Department of Transportation has utilized cracking and seating in comparison with sections that have not been cracked and seated. These experimental projects have shown reduced reflection cracking in the cracked and seated sections, at least on the short term. These reports of success have generated enough interest in Iowa that three cracking and seating projects were completed in 1986.

The other two projects were on secondary roadways in Hamilton and Fremont Counties.

PROJECT LOCATION AND CONTRACTUAL ARRANGEMENTS

The experimental cracking and seating prior to asphalt concrete (AC) overlay was incorporated into an eight mile Shelby County resurfacing project FR-59-4(22)--2G-83. The cracking and seating was incorporated into the south end of the project south of Iowa Route 44 at Harlan. The traffic volume on this section is currently 2,650 ADT which includes 400 (15.1%) trucks. The successful bidder on the project, let May 13, 1986, was Western Engineering Co., Inc. of Harlan, Iowa. The 24,667 sq. yd. of cracking and seating was bid at $0.85 per sq. yd.

PRECONSTRUCTION CONDITION

The PCC pavement to be cracked was constructed as US 69 relocation in 1970. It was slipformed, 24' wide and 9" thick with sawed contraction joints without load transfer at a 20'spacing. The pavement was constructed on earth subgrade. The concrete mix proportions included 626 lbs. of Type I cement, 1,478 lbs. sand, 1,472 lbs. of crushed limestone with 6% air (an Iowa DOT C-4 mixture). Test of concrete beams made during construction yielded flexural strength modulus of rupture generally greater than 600 psi at 7 days of age.

Recent surface restoration reviews prior to October 1985 showed severe D-cracking requiring surface patching of many joints. This

D-cracking deterioration is attributed to the use of crushed limestone coarse aggregate from the Logan Quarry in Harrison County. This coarse aggregate has yielded poor durability performance and has subsequently been rated as a Class 1 (showing visible deterioration in less than 10 years) and, as such, is no longer permitted in primary pavement nor in most secondary pavements. This loss of structure due to the severe joint deterioration made it a prime candidate for experimental cracking and seating.

MATERIALS

Mix designs (Appendix A) were developed for both a Type B asphalt concrete binder course and a Type A asphalt concrete surface course. The Type B mix (Appendix A) included 25% of a 3/4" top size crushed limestone and 20% 3/8" crushed limestone from the Clarke Limestone Co., Logan Pit at Logan, Iowa, in Harrison County. There was also 55% of a gravel material from Finley, Inc., Harlan Pit in Shelby County. These proportions provided a mixture that required a design asphalt content of 6.4%.

The Type A surface course was a three aggregate mix design. It included 25% of a 1/2" and 40% of a 3/8" crushed limestone; both from Clark Limestone Logan Quarry in Harrison County, and 35% of a gravel produced by Finley, Inc. from the Harlan Pit in Shelby County. The design for this aggregate mixture required 5.4% asphalt cement.

The asphalt cement was an AC-10 grade supplied by Koch of Omaha, Nebraska.

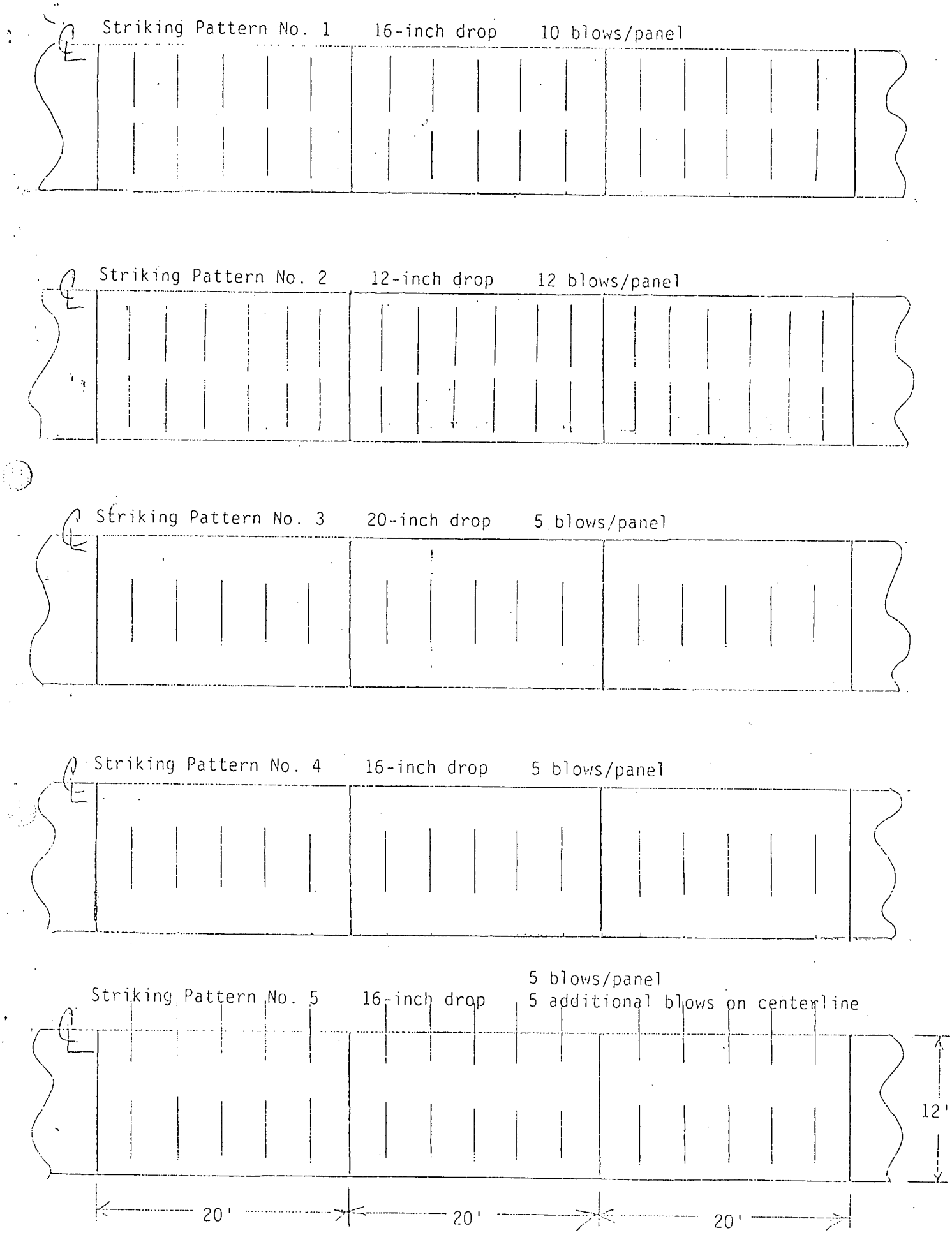
CONSTRUCTION

The cracking and seating of the pavement was conducted in accordance with Supplemental Specification 1023 (Appendix B). Some partial depth patching had been completed prior to the first day of the asphalt concrete laydown operation. The cracking and seating on this project had been subcontracted to Antigo Construction of Wisconsin. Antigo Construction utilized a Wirtgen breaker with a 6 ton guillotine (blade type) head. The width of the head was approximately 58" and was equipped with a 2" wide metal blade striking edge. A test section was established in the southbound lane at the north end of the designated crack and seat area near Station 498 to determine the proper pattern with the Wirtgen breaker.

Pattern No. 1 (Figure 1) established a 16" drop with 10 blows between each transverse joint per lane. This pattern produced excessive continuous longitudinal cracks and the decision was made to reduce the energy input.

Pattern No. 2 utilized only a 12" drop but the number of strikes per lane (12' wide) between transverse joints (20' spacing) was increased to 12. This also appeared to be too much energy as there was excessive longitudinal cracking.

Figure 1 – Wirtgen Striking Pattern Trials



Pattern No. 3 was a series of drops positioned in the center of the lane with 5 blows between transverse joints. A drop of 20" was utilized for this pattern. Pattern No. 3 produced excessive force on the slab with unpredictable cracks in all directions. The pattern severely fractured the pavement.

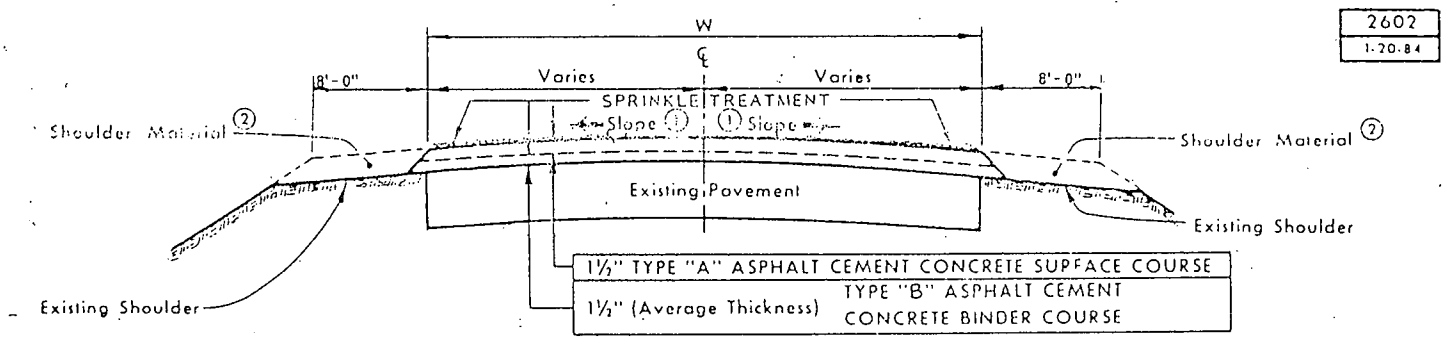
Pattern No. 4 was essentially the same as pattern No. 3 except that the height of drop was reduced to 16". This pattern reduced the adverse cracking, however, the transverse cracks that developed seemed to propagate toward the outside of the pavement at a 45° angle.

Pattern No. 5 utilized three series of blows per full width of pavement. One series of five blows was placed approximately 1' from the outside edge which generally produced a transverse crack across the panel. Another corresponding series was placed 1' from the other edge of pavement. A third row of impacts was located at centerline to assure that the full width of the panel had been cracked. Pattern No 5 was selected for use on the project. The transverse cracks produced were not readily visible on the pavement surface. Applying water did enhance their appearance in some cases. The fractures generally were very fine and were confirmed by coring the pavement. Pavement cores did show the development of cracks in the pavement. Aggregate interlock was not sacrificed as the cores did not readily split when removed from the drill bit. There were some longitudinal cracks that were readily apparent from

the surface. The transverse cracks did not always develop directly under the impact area.

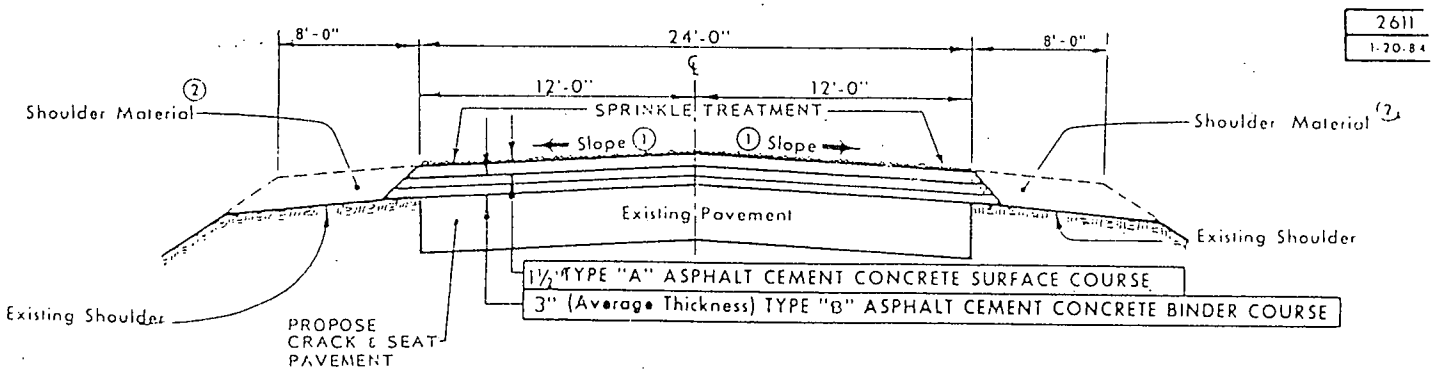
The seating was accomplished with a pneumatic roller (approximately 6' wide) with a gross load of 50 tons towed by a large farm tractor. Two roller passes were made in each lane. The first pass was over the outside 6 feet followed by a pass next to centerline on the inside 6 feet. It was very difficult to visibly detect movement but cracking sounds could be heard.

Asphalt laydown operations began with the Type B binder course on August 26, 1986. The total thickness of asphalt concrete resurfacing varied from 3" to 6" (Table 1). The Type A surface course remained at 1 1/2" but the thickness of the Type B binder varied from 1 1/2" to 4 1/2" in thickness (Figure 2 & 3). All asphalt concrete was produced in an Aztec drum type mixer at Harlan, Iowa. The contractor achieved densities of approximately 97% in regard to the 2.33 laboratory density (Appendix C). This yielded voids of approximately 5%. The placement of all binder courses was completed on September 16, 1986. The 1 1/2" Type A surface course was placed from September 17, 1986, through September 30, 1986. The densities again were approximately 97% of the laboratory density that ranged from 2.36 to 2.38. This also yielded a void content of approximately 5%.



TYPICAL CROSS SECTION
ASPHALT CEMENT CONCRETE RESURFACING

Figure 2



TYPICAL CROSS SECTION
ASPHALT CEMENT CONCRETE RESURFACING

Figure 3

Table 1

CRACKING & SEATING - US 59 AT HARLAN

From	To	Description of Section	
407+50	408+62.5	Taper 0 to 4½"	No Cracking
408+62.5	416+00	4½"	No Cracking
416+00	424+62.5	4½"	Crack & Seat
424+62.5	425+00	Taper 4½" to 6"	Crack & Seat
425+00	440+00	6"	Crack & Seat
440+00	440+37.5	Taper 6" to 4½"	Crack & Seat
440+37.5	482+62.5	4½"	Crack & Seat
482+62.5	483+00	Taper 4½" to 3"	Crack & Seat
483+00	498+00	3"	Crack & Seat
498+00	505+40	3"	No Cracking

TESTING AND EVALUATION

No reflective cracking has been identified to date. The average Profile Index (Appendix D) of the southbound lane from Station 406+69 to 505+45 (the area where the cracking and seating was incorporated in experimental sections) averaged 5.5 inches per mile. The northbound lane from Station 406+69 to 505+40 averaged 3.3 inches per mile.

The structural capacity of the original pavement prior to cracking and seating was determined with the Iowa DOT Road Rater on August 18, 1986 (Appendix E). The average structural rating northbound was 3.97, southbound was 3.64, for an average structural rating of the test sections of 3.81. The average structural rating after asphalt concrete resurfacing was obtained on October 9, 1986. The northbound lane had a structural rating of 5.22 while the southbound lane had a structural rating of 4.66 for an average structural rating of 4.94. This improvement in structural rating

would be attributed to the additional thickness of asphalt concrete. Based upon the improvement from 3.81 to 4.94 (1.07) and the layer coefficient for hot mix asphalt concrete of 0.44 per inch, it would appear that some structural rating was lost due to the cracking. The 4 1/2" of asphalt concrete would theoretically add structural rating in the amount of (1.98 (4 1/2 x 0.44).

The evaluation will include crack surveys, Road Rater testing and profilometer testing annually for three years.

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
ASPHALT CONCRETE MIX DESIGN
LAB LOCATION AMES

MIX, TYPE AND CLASS: TYPE A LAB NO. ABDS-256

INTENDED USE: SURFACE

SIZE SPEC. NO. 1000 DATE REPORTED 8-27-85

COUNTY SHELBY PROJECT FR-59-4(21)--2G-83

CONTRACTOR WESTERN ENGR.

PROJ. LOCATION VARIOUS LOCATIONS FROM HARLAN TO CRAWFORD CO.

AGG. SOURCES 1/2" & 3/8" CR. LST.-CLARK LST.; HARRISON CO.; SAND - G. A. FINLEY, HARLAN, SHELBY CO.

JOB MIX FORMULA AGGREGATE PROPORTIONS: 25% AAT5-980; 40% AAT5-981; 35% AAT5-983

JOB MIX FORMULA - COMBINED GRADATION

1-1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
		100	99	86	62	47	34	23	9.2	6.0	4.9
TOLERANCE:			98/100	7	7	5		4			2

75 BLOW MARSHALL DENSITY		2.367	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY	KOCH - 1110 POISES		
PLASTICITY INDEX			
% IN MIX	4.5	5.5	6.5
NO. OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY - LBS.	1883	2105	1845
FLOW - 0.01 IN.	7	7	11
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.306	2.351	2.357
BULK SP. GR. COMB. DRY AGG.	2.645	2.645	2.645
SP. GR. ASPH. @ 77 F.	1.037	1.037	1.037
CALC. SOLID SP.GR.	2.493	2.457	2.422
% VOIDS - CALC.	7.52	4.33	2.69
RICE SP. GR.	2.468	2.435	2.402
% VOIDS - RICE	6.56	3.45	1.87
% WATER ABSORPTION - AGGREGATE	0.74	0.74	0.74
% VOIDS IN THE MINERAL AGGREGATE	16.47	16.00	16.68
% V.M.A. FILLED WITH ASPHALT	55.08	72.96	83.85
CALCULATED ASPH.FILM THICKNESS(MICRONS)	8.34	10.47	12.64
FILLER/BITUMEN RATIO		0.91	

A CONTENT OF 5.40% ASPHALT IS RECOMMENDED TO START THE JOB.

COPIES:
ASPHALT MIX DESIGN
FR-59-4(21)--2G-83, SHELBY
VAN SNYDER
J. ARN
R. MONROE
JORDISON
HEINS
WESTERN ENGR.
W. OPPEDAL

Use in 1986 For:
Shelby-FR-59-4(22)--2G-83 ✓
cc: Ames Lab ✓
Bill Burgan
Western Engr
Atlantic Lab.
File
Mix Book

Orig Bill
9-27-85
Western 9-30

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - BITUMINOUS AGGREGATE
LAB LOCATION - AMES

MATERIAL: AGGR. FOR TYPE-A ASPH. (NO GIVEN S LAB NO.: AATS-0983

INTENDED USE: SURFACE

COUNTY: SHELBY PROJ NO.: FR-59-4(21)--2G-83

DESIGN: CONTRACT NO.: 24519

PRODUCER: FINLEY INC CONTRACTOR: WESTERN ENGR.

SOURCE: HARLAN NE-36-079N-39W, SHELBY QTY:

SAMPLE LOCATION :

SAMPLE DESC.:

SAMPLED BY: SENDER'S NO.: 4MDS-069

DATE SAMPLED: / / REC'D: 08/21/85 REPORTED: 08/29/85

TO BE USED WITH 4MDS-67 - 25% & 4MDS-68 - 40%

	3/8	#4	#8	#16	#30	#50	#100	#200
FIELD % PSG.	100.0	96.0	82.0	69.0	46.2	9.2	2.4	0.5

COPIES:
PROJECT
GEOLOGY
BITUMINOUS AGGREGATE
DIST - 4, DIST - 3,
J. ARA,

DISPOSITION:

SIGNED: BERNARD C. BROWN
F = NON-COMPLIANCE
* = SPEC NOT CHECKED
@ = CORRECTED ITEM

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - BITUMINOUS AGGREGATE
LAB LOCATION - AMES

MATERIAL: -·CR. STONE — LAB NO.: AATS-0981

SIZE: 3/8

INTENDED USE: SURFACE

COUNTY: SHELBY — PROJ NO.: FR-59-4(21)--2G-83

DESIGN: — CONTRACT NO.: 24519

PRODUCER: CLARK LS CO — CONTRACTOR: WESTERN ENGR.

SOURCE: LOGAN QUARRY -17-079N-42W, HARRISON — QTY:

SAMPLE LOCATION :

SAMPLE DESC.:

SAMPLED BY: — SENDER'S NO.: 4MDS-068

DATE SAMPLED: / / — REC'D: 08/21/85 — REPORTED: 09/04/85

TO BE USED WITH 4MDS-67 25%, 4MDS-69 35%

	3/8	#4	#8	#16	#30	#50	#100	#200
FIELD % PSG.	100.0	69.0	38.0	23.0	17.0	14.0	12.0	11.0

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IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - BITUMINOUS AGGREGATE
LAB LOCATION - AMES

MATERIAL: TYPE A ASPHALT-CR. STONE 1/2" LAB NO.: AATS-0980

SIZE: 1/2

INTENDED USE: SURFACE

COUNTY: SHELBY PROJ NO.: FR-59-4(21)--2G-83

DESIGN: CONTRACT NO.: 24519

PRODUCER: CLARK LS CO CONTRACTOR: WESTERN ENGR.

SOURCE: LOGAN QUARRY -17-079N-43W, HARRISON QTY:

SAMPLE LOCATION :

SAMPLE DESC.:

SAMPLED BY: SENDER'S NO.: 4MDS-067

DATE SAMPLED: / / REC'D: 08/21/85 REPORTED: 09/04/85

TO BE USED WITH 4MDS-68 40%, 4MDS-69 35%

FIELD	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% PSG.	100.0	96.0	43.0	4.0	2.4	1.8	1.5	1.5	1.4	1.3

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DIST - 4, DIST - 3,
J. ARN,

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* = SPEC NOT CHECKED
@ = CORRECTED ITEM

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
ASPHALT CONCRETE MIX DESIGN
LAB LOCATION AMES

MIX, TYPE AND CLASS: TYPE B LAB NO. ABD6-180

INTENDED USE: BINDER

SIZE 3/4" SPEC. NO. 1024 DATE REPORTED 8/21/86

COUNTY SHELBY PROJECT FR-59-4(22)--2G-83

CONTRACTOR WESTERN ENGR.

PROJ. LOCATION FROM 2 MILES SO. IOWA 49 NORTH 8 MILES

AGG. SOURCES CR. LST. & 3/4" CHIPS - CLARK LIMESTONE, LOGAN, HARRISON CO.;
PIT RUN - G. A. FINLEY, HARLAN, SHELBY CO.
JOB MIX FORMULA AGGREGATE PROPORTIONS: 20% AAT6-800; 25% AAT6-801; 55% AAT6-802

JOB MIX FORMULA - COMBINED GRADATION										
1-1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
		100	92	78	64	54	45	33	17	8.8	7.0
TOLERANCE: 98/100			7	7	6		5				3*

ASPHALT SOURCE AND APPROXIMATE VISCOSITY	KOCH - 1090 POISES		
PLASTICITY INDEX	N. P.		
% ASPH. IN MIX	5.25	6.25	7.25
NUMBER OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY - LBS.	1895	1853	1443
FLOW - 0.01 IN.	8	10	14
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.280	2.303	2.312
BULK SP. GR. COMB. DRY AGG.	2.620	2.620	2.620
SP. GR. ASPH. @ 77 F.	1.031	1.031	1.031
CALC. SOLID SP.GR.	2.461	2.425	2.391
% VOIDS - CALC.	7.35	5.05	3.30
RICE SP. GR.	2.433	2.401	2.360
% VOIDS - RICE	6.29	4.08	2.03
% WATER ABSORPTION - AGGREGATE	1.35	1.35	1.35
% VOIDS IN THE MINERAL AGGREGATE	17.55	17.59	18.15
% V.M.A. FILLED WITH ASPHALT	58.11	71.32	81.83
CALCULATED ASPH.FILM THICKNESS(MICRONS)	6.67	8.22	9.80
FILLER/BITUMEN RATIO		1.09	

A CONTENT OF 6.4% ASPHALT IS RECOMMENDED TO START THE JOB.
* ALSO CONTROLLED BY FILLER/BITUMEN RATIO.
COPIES:
ASPH. MIX DESIGN
FR-59-4(22)--2G-83, SHELBY
V. R. SNYDER
W. G. BURGAN
R. MONROE
J. SMYTHE
D. HEINS
WESTERN ENGR.
W. OPPEDAL

SIGNED: MAX I. SHEELER
TESTING ENGINEER

MIX DESIGN

Appendix A-6

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - BITUMINOUS AGGREGATE
LAB LOCATION - AMES

MATERIAL: TYPE - B ASPHALT LAB NO.: AAT6-0800

CLASS: 1 SIZE: 3/8

INTENDED USE: BINDER

COUNTY: SHELBY PROJ NO.: FR-59-4(22)--26-83

DESIGN: CONTRACT NO.: 25602

PRODUCER: CLARK LS CO CONTRACTOR: WESTERN ENGR.

SOURCE: LOGAN -17-079N-42W, HARRISON QTY: 0 TONS

SAMPLE LOCATION : HERTHA LEDGE

SAMPLE DESC.:

SAMPLED BY: DIST. 3 SENDER'S NO.: 4MD6-039

DATE SAMPLED: / / REC'D: 08/19/86 REPORTED: 08/26/86

TO BE USED WITH 4MD6-35 55%; 4MD6-38 25% AC-10

	3/8	#4	#8	#16	#30	#50	#100	#200
FIELD % PSG.	100.0	75.0	52.0	38.0	30.0	25.0	22.0	19.0

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GEOLOGY
BITUMINOUS AGGREGATE
DIST - 4,
W. BURGAN,

DISPOSITION:

SIGNED: MAX I. SHEELER

F = NON-COMPLIANCE
* = SPEC NOT CHECKED
@ = CORRECTED ITEM

MIX DESIGN

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - BITUMINOUS AGGREGATE
LAB LOCATION - AMES

MATERIAL: TYPE - B ASPHALT LAB NO.: AAT6-0801

CLASS: 1 SIZE: 3/4

INTENDED USE: BINDER

COUNTY: SHELBY PROJ NO.: FR-59-4(22)--2G-83

DESIGN: CONTRACT NO.: 25602

PRODUCER: CLARK LS CO CONTRACTOR: WESTERN ENGR.

SOURCE: LOGAN -17-079N-42W, HARRISON QTY: 0 TONS

SAMPLE LOCATION : HERTHA LEDGE

SAMPLE DESC.:

SAMPLED BY: DIST. 3 SENDER'S NO.: 4MD6-038

DATE SAMPLED: / / REC'D: 08/19/86 REPORTED: 08/26/86

TO BE USED WITH 4MD6-35 55%; 4MD6-39 20% AC-10 KOCH

FIELD	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% PSG.	100.0	74.0	29.0	5.2	4.2	3.7	3.3	3.0	2.7	2.5

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BITUMINOUS AGGREGATE
DIST - 4,
W. BURGAN,

DISPOSITION: SIGNED: MAX I. SHEELER
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IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - BITUMINOUS AGGREGATE
LAB LOCATION - AMES

MATERIAL: TYPE - B ASPHALT LAB NO.: AAT6-0802

CLASS: 1 SIZE: 3/4

INTENDED USE: BINDER

COUNTY: SHELBY PROJ NO.: FR-59-4(22)--2G-83

DESIGN: CONTRACT NO.: 25602

PRODUCER: FINLEY INC CONTRACTOR: WESTERN ENGR.

SOURCE: HARLAN NE-36-079N-35W, SHELBY QTY:

SAMPLE LOCATION :

SAMPLE DESC.:

SAMPLED BY: GEARHART SENDER'S NO.: 4MD6-035

DATE SAMPLED: / / REC'D: 08/19/86 REPORTED: 08/26/86

TO BE USED WITH 4MD6-38 25%, 4MD6-39 20% AC-10 KOCH

	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
FIELD % PSG.	100.0	97.0	93.0	86.0	78.0	66.0	48.0	20.0	6.7	4.6

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DIST - 4,
W. BURGAN,

DISPOSITION:

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* = SPEC NOT CHECKED
a = CORRECTED ITEM

Specification 1023
New

Iowa Department of Transportation

SUPPLEMENTAL SPECIFICATIONS
for
CRACKING AND SEATING CONCRETE PAVEMENT

May 13, 1986

THE STANDARD SPECIFICATIONS, SERIES OF 1984, ARE AMENDED BY THE FOLLOWING ADDITIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

1023.01 DESCRIPTION. This work shall consist of cracking and seating existing PCC pavement, prior to resurfacing with ACC. Associated work may include removal of the existing ACC overlay, if present, and subdrain construction and shoulder work.

1023.02 EQUIPMENT. Cracking equipment shall be capable of producing the desired cracking pattern by providing a broad striking surface. Equipment that punches holes in the pavement or results in excessive spalling of otherwise sound sections shall not be used. A blade- or spade-type breaker is recommended and may be required.

Seating equipment shall be a roller meeting requirements of either Paragraph A or B, as follows:

A. The roller shall be a pneumatic-tired roller consisting of four rubber-tired wheels equally spaced across the full width and mounted in line on a rigid steel frame in such manner that all wheels carry equal loads, regardless of surface irregularities. Roller tires shall be capable of satisfactory operation at a minimum inflation pressure of 100 p.s.i., and tires shall be inflated to the pressure necessary to obtain proper surface contact pressure to satisfactorily seat pavement slabs. At the Contractor's option, tires may contain liquid. The roller shall have a weight body suitable for ballasting to a gross load of 50 tons, and ballast shall be such that gross roller weight can be readily determined and so controlled as to maintain a gross roller weight of 50 tons. The roller shall be towed with a rubber-tired prime mover.

B. The roller shall be a two-axle, self-propelled, pneumatic-tired roller, provided the roller is equipped with no more than seven tires, and the requirements in Paragraph A, above, concerning tire inflation pressure, surface contact pressure, and 50-ton gross weight are met.

Miscellaneous equipment shall include a means to dampen cracked pavement with water, a source of compressed air with 100 p.s.i. pressure, a rotary broom described in 2001.14, and various hand tools as needed.

Section 2214 shall apply to equipment for removal of existing ACC overlay. Removal by other methods and equipment will be allowed.

1023.03 REMOVAL OF EXISTING ACC OVERLAY. All asphaltic and other bituminous material existing on the pavement surface shall be removed from the area to be cracked before cracking the area. Removal shall be a continuous operation, but removal of asphaltic full-depth patches is not required. Removal shall be to the underlying PCC pavement and in accord with requirements of Section 2214, excluding 2214.05.

Foamed material in existing pressure-relief joints should be removed prior to removal of the ACC overlay.

Scarification shall be to the full width of the lane, with a suitable runout at the end, before the lane is opened to public traffic. Scarification shall be planned and done so as to leave no vertical dropoff at the centerline or lane line overnight. Where an overnight dropoff results from unforseen conditions, the approaches shall be signed with a ROAD WORK AHEAD sign, and the dropoff shall be marked with vertical panels. The vertical panels shall be placed at 150-foot intervals in rural areas and at 50-foot intervals in urban areas, with a minimum of three vertical panels at each dropoff location.

Additional scarification of the existing PCC pavement may be required at bridge approaches and other fixed objects, as designated on the plans.

1023.04 PAVEMENT CRACKING. The existing PCC pavement shall be cracked so as to produce full-depth, generally transverse, hairline cracks at a nominal spacing designated on the plans. When not designated, the spacing shall be 1 1/2 feet to 3 feet. Induced cracking closer than 2 1/2 feet from an existing crack or joint or deteriorated concrete shall be avoided. Care shall be taken to prevent the formation of a continuous longitudinal crack.

When cracking operations begin, the Engineer will designate test sections of approximately 100 feet. The Contractor shall crack the test sections using varying energy and striking patterns until a satisfactory cracking pattern is established. This energy and striking pattern shall then be used for the remainder of the project, unless the Engineer determines that a satisfactory cracking pattern is no longer being produced. Adjustments shall then be made to the energy and/or striking pattern as necessary to re-establish a satisfactory cracking pattern.

The Contractor shall furnish and apply water to the test area to dampen the pavement following cracking, to enhance visual determination of the cracking pattern. The Contractor shall furnish and apply water to check stations, as directed by the Engineer, to verify that the specified crack pattern is being maintained. This will normally be once a day. Furnishing and applying this water will be incidental, and it will not be paid for separately.

Cracking equipment shall not be operated on a bridge, and areas in a bridge-approach section or within 3 feet of a fixed object shall not be cracked.

Before opening to traffic, areas of cracked pavement shall be cleaned of loose or spalled material by sweeping and by blowing joints and cracks with compressed air. This cleaning shall be repeated, as necessary, until the ACC resurfacing is placed.

1023.05 PAVEMENT SEATING. Seating of the cracked pavement shall be done as shown on the plans and as required by the Engineer.

The cracked pavement shall be rolled until seating of the cracked pavement is assured to the satisfaction of the Engineer. The intentions are to weight the roller such that satisfactory seating can be reasonably assured by one complete coverage by the roller and to accomplish seating with a minimum damage to aggregate interlock at the cracks. The weight of the roller and the rolling pattern, including laps, will be established by the Engineer, based on one or more initial test sections.

1023.06 BASE REPAIR. Before the ACC overlay is placed, the cracked and seated pavement shall be prepared and repaired in accord with 2212.04, if required by the contract.

1023.07 SUBDRAINS. If subdrain work is included in the contract, the subdrains shall be constructed as designated. This work shall be completed in an area before ACC overlay is placed in that area.

1023.08 RESURFACING. The prepared base shall be resurfaced as shown on the plans and with the courses or lifts designated therein. Leveling courses may be designated on the plans or required by the Engineer, and these shall be compacted with Class II compaction.

1023.09 SHOULDER CONSTRUCTION. The shoulders shall be constructed as shown on the plans. Shoulder work shall be staged so as to provide surface drainage to all areas from which the existing ACC overlay has been removed or where the existing pavement has been cracked.

1023.10 LIMITATIONS. The Contractor shall use every reasonable means to protect persons and vehicles from injury or damage that might occur because of his operations. During the construction, the Contractor shall provide such traffic control as required by the plans. Articles 1107.08 and 1107.09 shall also apply.

The road shall be kept open to traffic. Except when an accelerated work schedule is required, no work will be permitted on Sundays and holidays. The Contractor may restrict traffic to one lane from 1/2 hour after sunrise to 1/2 hour before sunset but shall permit traffic to pass safely at all times, except for occasional, unavoidable interruptions. Equipment shall not extend into a lane open to traffic except the minimum distance necessary to perform the required work in the closed lane.

This work should be carefully staged to minimize the time public traffic is to drive on pavement where the pavement work is only partially completed. The removal of existing ACC overlay shall not be started more than 2 weeks before the succeeding operation is scheduled to begin. The pavement cracking shall not be started more than 2 weeks before the overlay operation of the cracked and seated area is scheduled to begin.

Cracked and seated areas are to be overlaid with the full thickness of ACC, required by the contract, before a winter suspension.

The Contractor's attention is directed to 1105.13. If the operation of the seating roller over a culvert is to be restricted according to Paragraph G, this will be so designated on the plans.

1023.11 METHOD OF MEASUREMENT. The Engineer will calculate the area of Cracking and Seating, satisfactorily completed, from the length and the nominal width. For areas cracked and seated according to the plans, the plan quantity shall be used.

1023.12 BASIS OF PAYMENT. For the number of square yards of Cracking and Seating completed, the Contractor will be paid the contract price per square yard. This payment will be full compensation for cracking and seating and for furnishing all materials, equipment, and labor therefore.

The work involved in removal of existing ACC overlay by scarification, preparation and repair of base, subdrain construction, ACC resurfacing and shoulder construction will be measured and paid for in accord with the Standard Specifications.

Form 820007
12-1 H-3785

Iowa Department of Transportation

DAILY PLANT REPORT

BITUMINOUS TREATED BASE, ASPHALT TREATED BASE, ASPHALT CONCRETE

County Shelby
Project FR-59-4(22)--26-83
Date 9/9/86
Report No. 7

Contractor Western Engr. Plant Location Harlan, IA
Plant Type Drum Make Astec Resident Engineer Wm. G. Burgan
Mix Type B Class Binder Size 3/4" Crushed Aggr. Sources Cr. Lst 1 3/4 chips Clark Limestone Logan
Asphalt Source Koch Omaha, NE. Sand Sources G. A. Finley Plant Operated 7:30 A.M. to 6:30 P.M.

SIEVE ANALYSIS OF COMBINED AGGREGATES

SAMPLE			SIEVE NO. - % PASSING												
JOB MIX FORMULA						98/100	92	83/71	57/71	48/60	45	25/35	17	8.8	4/10
No.	Time	Compliance	1½	1	¾	½	⅜	4	8	16	30	50	100	200	
7ec86	8:00	Comply			100	88	78	64	54	45	31	15	9.0	7.5	
9ec86	4:30	Comply			100	89	78	62	53	44	30	13	7.1	5.8	

SAMPLES SUBMITTED

Materials	Senders No.	Materials	Senders No.
Mix	7A	AC-10	13 AC
"	7B	"	14 AC
"	7C	"	15 AC

Asphalt Cement AC-10 Pen. Total Aggregate
Per Batch or Rev. Lb. Per Batch or Rev. Lb. Intended 6.20 % A.C. Tank Meas. 6.2 % A.C.

Lab. Den. 2.33 DENSITY RECORD SOLID DEN. 2.392

ASPHALT MATERIALS AND AGGREGATE DELIVERIES

Course Laid	Station	℄ Refer	Date Laid	* (1)	Density	% Density	% Voids	Grade	Car Or Tr. No.	Ticket No.	Time Unloaded	Quantity
Binder	451 +68	9.6 Lt	9/8/86	1 3/4	2.25	96.1	6.4	AC 10	528	1433	9/8/86	5707
"	477 + 18	2.5 Lt		1 3/4	2.25	96.6	5.9	AC 10	624	1446	11:30 PM	5716
"	500 + 14	8.3 Lt		2 1/4	2.23	95.7	6.8	"	538	1447	12:30 PM	5902
	513 + 37	18.6 Lt		2 3/8	2.31	99.1	3.4	"	510	1449	1:30 PM	5626
	547 +10	10.7 Lt		2	2.24	96.1	6.4					

TEMPERATURE RECORD

Time	7:30	9	11	1	3	5
Air	39	42	58	62	60	59
A.C.	290	295	310	305	300	300
Aggregate						
Mix	290	290	280	290	290	270
Mat	275	270	275	265	290	265

PRODUCTION AND PLACEMENT RECORD

* (2)	Side	Course Laid	From Station to Station	Tons Today	Tons To Date
1½	Lt	Binder	444 +70 553+75	1714.22	23328.22

Comments:

waste 30.12 T

Fines/Bitumen Ratio = $\frac{5.5}{6.20} = 0.89$

Ave. % Voids = 5.78

O.I. (Density) = (Show Calculation) $\frac{96.72 - 95}{99.1 - 95.7} = \frac{1.72}{3.4} = 0.50$

COMMENTS: Delays, Breakdowns, Corrective Action etc.
* Thickness: (1) Actual, (2) Intended
Bituminous Treated Base: Enter % Moisture in % Voids Column

SIGNED Claudia Combs 2839 Inspector

Claudia Combs - Cert#2839 - Worked plant, insp. duties today.

MATERIALS OFFICE—RECORDS CENTER COPY

Dennis D. Jones (State Monitor)

Form 820007 5-85 H-2086

Iowa Department of Transportation

DAILY PLANT REPORT

BITUMINOUS TREATED BASE, ASPHALT TREATED BASE, ASPHALT CONCRETE

County Shelby
Project FR-59-4(22)--2C-83
Date 9/23/86
Report No. 20

Contractor Western Engr. Plant Location Harlan IA
Plant Type Drum Make ASTEC Resident Engineer Wm. G. Burgan
Mix Type A Class Surface Size 1/2 Crushed Aggr. Sources Clark Limestone Recycle Source %
Asphalt Source Koch Omaha, NE Sand Sources G. A Finley Plant Operated 7:30 A.M. to 4:00 P.M.

SIEVE ANALYSIS OF COMBINED AGGREGATES

SAMPLE			SIEVE NO. - % PASSING												
JOB MIX FORMULA						98/100	79/93	55/69	43/52	34	19/27	9.2	60	3.9/6.9	
No.	Time	Compliance	1½	1	¾	½	⅜	4	8	16	30	50	100	200	
25CC86	8:00	Comply				98	86	65	51	39	26	12	6.9	5.7	

SAMPLES SUBMITTED

Materials	Senders No.
Mix	20 AE
Mix	20B
Mix	20C
Sprinkle Treatment	2ST

SAMPLES SUBMITTED

Materials	Senders No.
AC-10	40 AC
AC 10	41 AC
CSS-1H	2CSS-1H

Asphalt Cement AC 10 Grade Total Aggregate Intended Added % A.C.
Per Batch or Rev. Lb. Per Batch or Rev. Lb. Intended Total 5.40 % A.C. Tank Meas. 5.3 1 % A.C.

Lab. Den. 2.35 DENSITY RECORD SOLID DEN. 2.438

ASPHALT MATERIALS AND AGGREGATE DELIVERIES

Course Laid	Station	℄ Refer	Date Laid	* (1)	Density	% Density	% Voids	Grade	Car Or Tr. No.	Ticket No.	Time Unloaded	Quantity
Surface	519+38	19.1 LT	9/23/86	1½	2.29	97.4	6.1	AC10	528	1774	12:30	5842
"	526+92	1.1 LT	"	1 3/8	2.30	97.9	5.7	AC10	802	1781	2:30	5826
"	539+53	4.1 LT	"	1½	2.25	95.7	7.7					
"	566+81	9.8 LT	"	1½	2.26	96.1	7.3					
"	583+45	2.2 LT	"	1 5/8	2.28	97.0	6.5					

TEMPERATURE RECORD

Time	8:30	9	11	1	3	5
Air	54	56	58	62	66	
A.C.	305	310	300	300	310	
Aggregate						
Mix	320	310	300	290	300	
Mat	290	290	285	290	280	

* (2) Side

* (2)	Side	Course Laid
1½	LT	~~Surface~~ Surface
		Sprinkle

PRODUCTION AND PLACEMENT RECORD

From Station to Station	Tons Today	Tons To Date
505+45 - 585+80	1041.62	3718.26
	35.03	143.18

1	¾	½	⅜	4	8	16	30	50	100	200

Fines/Bitumen Ratio = $\frac{5.7}{3.31} = 1.07$

Ave. % Field Voids = 6.66

Lab % Voids = 3.6

O.I. (Density) = (Show Calculation) $\frac{96.82 - 95.0}{97.9 - 95.7} = \frac{1.82}{2.2} = 0.83$

Comments:

Waste 68.59

COMMENTS: Delays, Breakdowns, Corrective Action etc.
* Thickness: (1) Actual, (2) Intended
Bituminous Treated Base: Enter % Moisture in % Voids Column

SIGNED Claudia Combs 2839
Inspector

Claudia Combs - Cert # 2839 - Plant Insp. Dennis O Jans State Monitor Cert # 412

MATERIALS OFFICE – RECORDS CENTER COPY

WESTERN ENGINEERING CO. INC.
BOX 350
HARLAN, IOWA 51537
"ASPHALT PAVING SPECIALISTS"
PHONE
OFF. 712-755-5191

THE ROAD RUNNERS

25 FOOT CALIFORNIA PROFILOMETER

☐ Revised Report
Changes Lab. No. _____

For Information Only ☐ Preliminary ☐ Intermediate XX Final ☐

Lab. No. WECO 130 Route No. US #59 Project No. 59-4(22)--2C-83
Date Reported 9-24-86 Date Paved 9-17-86 County Shelby (83)
Tested at: ¼ Point XX Wheel Track ☐ Contractor Western Engineering Company, Inc.
Tested By L. E. Holtmyer Date 9-19-86
Trace Reduced By L. E. Holtmyer Date 9-22-86

Primary Schedule A ☒ PCC Slip Form ☐ ACC Paving ☐
Primary Schedule B ☐ PCC Fixed Form ☐ ACC Resurfacing XX
Secondary ☐ PCC Bonded Overlay ☐ ACC Patches ☐
Municipal ☐ PCC Unbonded Overlay ☐
Other ☐ PCC Patches ☐

Roadway Type: 2-Lane XX 4-Lane ☐ Ramp ☐ Other _____

N.B. XX E.B. ☐ ← Direction → S.B. ☐ W.B. ☐
Inside Lane ☐ ← (4-Lane Only) → Outside Lane ☐
Centerline ☐ ← (Patches Only) → ¼ Point XX

Northbound lane on US #59 406 + 69 to 456 + 10

Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)
.1	.55	5.5
.1	.10	1.0
.1	.20	2.0
.1	.20	2.0
.1	.15	1.5
.1	.20	2.0
.1	.25	2.5
.1	.40	4.0
.1	.60	6.0
.021	.20	9.524
.902	2.85	3.1596

Location (Station)	Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)

This is to certify that all testing and trace reduction herein described has been performed according to applicable contract specifications and requirements.

signed L. Holtmyer

Station ← ½" Bump Locations → Station

Copies: C. Potter - Ames
RCE - Red Oak
District Materials - Atlantic
File

WESTERN ENGINEERING CO. INC.
BOX 350
HARLAN, IOWA 51537
"ASPHALT PAVING SPECIALISTS"
PHONE
OFF. 712-755-5191

THE ROAD RUNNERS

Appendix D-2

25 FOOT CALIFORNIA PROFILOMETER

☐ Revised Report
Changes Lab. No. _____

For Information Only ☐ Preliminary ☐ Intermediate [XX] Final ☐

Lab. No. WECO 131 Route No. US #59 Project No. FR-59-4(22)--2G-83
Date Reported 9-24-86 Date Paved 9-18-86 County Shelby (83)
Tested at: ¼ Point [XX] Wheel Track ☐ Contractor Western Engineering Company, Inc.
Tested By L. E. Holtmyer Date 9-19-86
Trace Reduced By L. E. Holtmyer Date 9-22-86

Primary Schedule A [X] PCC Slip Form ☐ ACC Paving ☐
Primary Schedule B ☐ PCC Fixed Form ☐ ACC Resurfacing [XX]
Secondary ☐ PCC Bonded Overlay ☐ ACC Patches ☐
Municipal ☐ PCC Unbonded Overlay ☐
Other ☐ PCC Patches ☐

Roadway Type: 2-Lane [XX] 4-Lane ☐ Ramp ☐ Other _____

N.B. [XX] E.B. ☐ Direction S.B. ☐ W.B. ☐
Inside Lane ☐ (4-Lane Only) Outside Lane ☐
Centerline ☐ (Patches Only) ¼ Point [XX]

Northbound lane on US #59 456 + 10 to 505 + 40

Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)
.1	.60	6.0
.1	.20	2.0
.1	.25	2.5
.1	.40	4.0
.1	.65	6.5
.1	.60	6.0
.1	.15	1.5
.1	.20	2.0
.1	.10	1.0
.034	.15	4.412
.934	3.30	3.532

This is to certify that all testing and trace reduction herein described has been performed according to applicable contract specifications and requirements.

signed _____

Station ⟵ ½" Bump Locations ⟶ Station

Copies C. Potter Ames
RCE - Red Oak
Dist. Mat. - Atlantic
File

WESTERN ENGINEERING CO. INC.
BOX 350
HARLAN, IOWA 51537
"ASPHALT PAVING SPECIALISTS"
PHONE
OFF. 712-755-5191

THE ROAD RUNNERS

25 FOOT CALIFORNIA PROFILOMETER

☐ Revised Report
Changes Lab. No. _____

For Information Only ☐ Preliminary ☐ Intermediate [XX] Final ☐

Lab. No. WECO 133 Route No. US #59 Project No. FR-59-4(22)--2G-83
Date Reported 9-24-86 Date Paved 9-20-86 County Shelby (83)
Tested at: ¼ Point [XX] Wheel Track ☐ Contractor Western Engineering Company, Inc.
Tested By L. E. Holtmyer Date 9-23-86
Trace Reduced By L. E. Holtmyer Date 9-23-86

Primary Schedule A [XX] PCC Slip Form ☐ ACC Paving ☐
Primary Schedule B ☐ PCC Fixed Form ☐ ACC Resurfacing [XX]
Secondary ☐ PCC Bonded Overlay ☐ ACC Patches ☐
Municipal ☐ PCC Unbonded Overlay ☐
Other ☐ PCC Patches ☐

Roadway Type: 2-Lane [XX] 4-Lane ☐ Ramp ☐ Other _____

N.B. ☐ E.B. ☐ ← Direction → S.B. [XX] W.B. ☐
Inside Lane ☐ ← (4-Lane Only) → Outside Lane ☐
Centerline ☐ ← (Patches Only) → ¼ Point [XX]

Southbound lane 406 + 69 to 438 + 65

Trace ran North to South
Paved South to North

Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)	Location (Station)	Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)
				.1	.25	2.5
				.1	.30	3.0
				.1	.30	3.0
				.1	.85	8.5
				.1	.80	8.0
				.091	.55	6.04
				.591	3.05	5.161

This is to certify that all testing and trace reduction herein described has been performed according to applicable contract specifications and requirements.

signed L. E. Holtmyer

Station ← ½" Bump Locations → Station

Copies: C. Potter - Ames
RCE - Red Oak
Dist. Materials - Atlantic
File

BOX 350
HARLAN, IOWA 51537
"ASPHALT PAVING SPECIALISTS"
PHONE
OFF. 712-755-5191

THE ROAD RUNNERS

25 FOOT CALIFORNIA PROFILOMETER

☐ Revised Report
Changes Lab. No. _____

For Information Only ☐ Preliminary ☐ Intermediate [XX] Final ☐

Lab No. WECO 134 Route No. US #59 Project No. FR-59-4(22)--2C-83
Date Reported 9-24-86 Date Paved 9-22-86 County Shelby (83)
Tested at: ¼ Point [XX] Wheel Track ☐ Contractor Western Engineering Company, Inc.
Tested By L. E. Holtmyer Date 9-23-86
Trace Reduced By L. E. Holtmyer Date 9-23-86

Primary Schedule A [XX] PCC Slip Form ☐ ACC Paving ☐
Primary Schedule B ☐ PCC Fixed Form ☐ ACC Resurfacing [XX]
Secondary ☐ PCC Bonded Overlay ☐ ACC Patches ☐
Municipal ☐ PCC Unbonded Overlay ☐
Other ☐ PCC Patches ☐

Roadway Type: 2-Lane [XX] 4-Lane ☐ Ramp ☐ Other _____

N.B. ☐ E.B. ☐ ← Direction → S.B. [XX] W.B. ☐
Inside Lane ☐ ← (4-Lane Only) → Outside Lane ☐
Centerline ☐ ← (Patches Only) → ¼ Point [XX]

Southbound lane 438 + 65 to 505 + 45

Trace ran North to South
Paved South to North

Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)	Location (Station)	Length (Miles)	Measured Roughness (Inches)	Profile Index (Inches/Miles)
				.1	.30	3.0
				.1	.00	0.0
				.1	.15	1.5
				.1	.85	8.5
				.1	.60	6.0
				.1	.35	3.5
				.1	.55	5.5
				.1	.80	8.0
				.1	.95	9.5
				.1	.95	9.5
				.1	1.10	11.0
				.1	.60	6.0
				.064	.05	.78
				1.264	7.25	5.7357

This is to certify that all testing and trace reduction herein described has been performed according to applicable contract specifications and requirements.

signed _____

Station ← ½" Bump Locations → Station

Copies. C. Potter - Ames
RCE - Red Oak
Dist. Mat. - Atlantic
File

PROGRAM NUMBER- P2220050
COMPUTER RUN DATE- 09-04-86

OFFICE OF MATERIALS
ROAD RATER TESTS

COUNTY- SHELBY
U.S. ROUTE..... 0059
PAVEMENT TYPE... PC

BEGINNING MP.... 407.50
ENDING MP..... 500.00
COMPUTED MILES.. 92.50

LAB NO..... RA6-5433
YEAR BUILT.. 1970
DATE TESTED. 08-18-86

WEATHER CLOUD
OBS.... TWOHEY JONES
TIME... 10:45

FREQ. HZ... 30
DISP %..... 68
TEST TYPE.. SI

ROAD RATER DEFLECTION (MILS)

	NORTHBOUND						SOUTHBOUND						
M-P	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	REMARKS
409.000							1.70	1.60	1.50	1.30	3.43	68.	
410.000	1.40	1.30	1.10	0.90	4.02	125.							
411.000							1.70	1.60	1.50	1.20	3.43	68.	
412.000	1.20	1.10	0.90	0.80	4.56	155.							
413.000							1.60	1.50	1.40	1.10	3.60	89.	
414.000	1.50	1.40	1.10	1.00	3.80	107.							
415.000							1.70	1.60	1.50	1.20	3.43	68.	
416.000	1.40	1.30	1.00	0.80	4.02	125.							
417.000							1.60	1.50	1.30	1.10	3.60	89.	
418.000	1.20	1.10	1.00	0.80	4.56	155.							
419.000							1.30	1.20	1.10	0.90	4.27	141.	
420.000	1.30	1.20	1.00	0.90	4.27	141.							
421.000							1.20	1.10	1.00	0.80	4.56	155.	
422.000	1.20	1.10	1.00	0.80	4.56	155.							
423.000							1.20	1.10	1.00	0.80	4.56	155.	
424.000	1.30	1.20	1.00	0.80	4.27	141.							
425.000	1.10	1.00	0.90	0.80	4.90	169.							
425.500							1.30	1.20	1.10	0.90	4.27	141.	
426.000	1.20	1.10	1.00	0.80	4.56	155.							
426.500							1.30	1.20	1.10	0.90	4.27	141.	
427.000	1.20	1.10	1.00	0.90	4.56	155.							
427.500							1.50	1.40	1.30	1.10	3.80	107.	
428.000	1.40	1.30	1.20	1.00	4.02	125.							
428.500							1.50	1.40	1.30	1.20	3.80	107.	
429.000	1.50	1.40	1.30	1.10	3.80	107.							
429.500							1.80	1.70	1.60	1.40	3.27	50.	
430.000	1.50	1.30	1.20	1.00	3.80	173.							
430.500							1.60	1.50	1.30	1.10	3.60	89.	
431.000	1.60	1.50	1.40	1.20	3.60	89.							
431.500							2.10	2.00	1.80	1.60	2.88	50.	
432.000	1.60	1.50	1.40	1.20	3.60	89.							
432.500							1.50	1.40	1.30	1.00	3.80	107.	
433.000	1.70	1.60	1.50	1.20	3.43	68.							
433.500							1.80	1.70	1.60	1.50	3.27	50.	
434.000	1.40	1.20	1.10	1.00	4.02	185.							
434.500							2.00	1.90	1.80	1.60	3.00	50.	
435.000	1.40	1.30	1.20	1.00	4.02	125.							
435.500							2.30	2.20	2.10	1.80	2.67	50.	
436.000	1.50	1.40	1.20	1.00	3.80	107.							
436.500							1.90	1.80	1.70	1.50	3.13	50.	
437.000	2.00	1.80	1.70	1.50	3.00	88.							
437.500							1.60	1.50	1.40	1.20	3.60	89.	
438.000	2.70	2.00	1.80	1.70	2.34	181.							
438.500							2.20	2.10	2.00	1.70	2.77	50.	
439.000	2.20	2.00	1.90	1.70	2.77	50.							
439.500							1.90	1.80	1.70	1.50	3.13	50.	
441.000							2.00	1.90	1.80	1.60	3.00	50.	
442.000	1.30	1.20	1.00	0.80	4.27	141.							
443.000							1.60	1.50	1.40	1.20	3.60	89.	
444.000	1.00	0.90	0.80	0.60	5.30	182.							

445.000						
446.000	1.40	1.30	1.10	0.90	4.02	125.
447.000						
448.000	1.60	1.50	1.30	1.10	3.60	89.
449.000						
450.000	1.40	1.20	1.10	0.90	4.02	185.
451.000						
452.000	1.30	1.10	1.00	0.90	4.27	196.
453.000						
454.000	1.40	1.30	1.10	0.90	4.02	125.
455.000						
456.000	1.40	1.30	1.20	1.00	4.02	125.
457.000						
458.000	1.20	1.00	0.90	0.80	4.56	206.
459.000						
460.000	1.60	1.50	1.40	1.20	3.60	89.
461.000						
462.000	1.30	1.20	1.10	0.90	4.27	141.
463.000						
464.000	1.40	1.30	1.20	0.90	4.02	125.
465.000						
466.000	1.40	1.30	1.20	1.10	4.02	125.
467.000						
468.000	1.70	1.60	1.50	1.30	3.43	68.
469.000						
470.000	1.40	1.30	1.20	1.00	4.02	125.
471.000						
472.000	1.40	1.30	1.20	1.00	4.02	125.
473.000						
474.000	1.40	1.30	1.10	0.90	4.02	125.
475.000						
476.000	1.50	1.40	1.30	1.00	3.80	107.
477.000						
478.000	1.50	1.40	1.20	1.00	3.80	107.
479.000						
480.000	1.50	1.40	1.20	1.00	3.80	107.
481.000						
482.000	1.50	1.40	1.10	0.90	3.80	107.
483.000						
484.000	1.50	1.40	1.20	0.90	3.80	107.
485.000	1.20	1.10	1.00	0.80	4.56	155.
485.500						
486.000	1.20	1.10	1.00	0.80	4.56	155.
486.500						
487.000	1.20	1.10	1.00	0.80	4.56	155.
487.500						
488.000	1.10	1.00	0.80	0.70	4.90	169.
488.500						
489.000	1.80	1.70	1.50	1.20	3.27	50.
489.500						
490.000	1.40	1.30	1.10	1.00	4.02	125.
490.500						
491.000	1.20	1.10	1.00	0.80	4.56	155.
491.500						
492.000	1.50	1.40	1.30	1.00	3.80	107.
492.500						
493.000	1.60	1.50	1.40	1.20	3.60	89.
493.500						
494.000	1.50	1.30	1.20	0.90	3.80	173.
494.500						
495.000	1.40	1.30	1.10	0.90	4.02	125.
495.500						
496.000	1.40	1.30	1.10	0.90	4.02	125.
496.500						
	1.50	1.40	1.30	1.00	3.80	107.
	2.10	2.00	1.80	1.50	2.88	50.
	1.80	1.70	1.50	1.20	3.27	50.
	1.70	1.60	1.40	1.00	3.43	68.
	1.40	1.30	1.20	1.00	4.02	125.
	1.40	1.30	1.20	1.00	4.02	125.
	1.30	1.20	1.00	0.80	4.27	141.
	1.50	1.40	1.30	1.00	3.80	107.
	1.50	1.40	1.30	1.10	3.80	107.
	1.60	1.50	1.40	1.10	3.60	89.
	1.40	1.30	1.10	0.90	4.02	125.
	1.60	1.50	1.40	1.30	3.60	89.
	1.50	1.40	1.30	1.00	3.80	107.
	1.50	1.40	1.30	1.10	3.80	107.
	1.80	1.70	1.50	1.10	3.27	50.
	1.40	1.30	1.20	0.90	4.02	125.
	1.50	1.40	1.20	1.00	3.80	107.
	1.40	1.30	1.10	0.90	4.02	125.
	1.60	1.40	1.20	1.00	3.60	159.
	1.50	1.40	1.20	1.00	3.80	107.
	1.20	1.10	1.00	0.70	4.56	155.
	1.20	1.00	0.90	0.70	4.56	206.
	1.20	1.10	1.00	0.80	4.56	155.
	1.80	1.60	1.50	1.30	3.27	127.
	1.70	1.60	1.40	1.20	3.43	68.
	1.40	1.20	1.10	0.80	4.02	185.
	1.40	1.20	1.10	0.90	4.02	185.
	1.50	1.40	1.30	1.20	3.80	107.
	2.20	2.10	2.00	1.80	2.77	50.
	1.50	1.40	1.30	1.00	3.80	107.
	1.40	1.20	1.10	1.00	4.02	185.
	1.50	1.40	1.30	1.20	3.80	107.

497.000	1.80	1.70	1.60	1.30	3.27	50.	2.30	2.10	1.90	1.60	2.67	50.		
497.500														
498.000	2.00	1.90	1.80	1.50	3.00	50.	2.30	2.20	2.10	1.80	2.67	50.		
498.500														
499.000	1.60	1.50	1.40	1.80	3.60	89.	2.10	2.00	1.80	1.60	2.88	50.		
499.500														

* S U M M A R Y O F D A T A * * * * * * * * * * * * * * * * * * *

PROGRAM NUMBER- P2220050
COMPUTER RUN DATE- 10-22-86

OFFICE OF MATERIALS
ROAD RATER TESTS

COUNTY- SHELBY
U.S. ROUTE..... 0059
PAVEMENT TYPE... COMP

BEGINNING MP.... 407.50
ENDING MP..... 500.00
COMPUTED MILES.. 92.50

LAB NO..... RA6-5463
YEAR BUILT.. 1970
DATE TESTED. 10-09-86

WEATHER CLOUD
OBS.... FRETTE JONES
TIME... 07:30

FREQ. HZ... 30
DISP %..... 68
TEST TYPE:. SI

ROAD RATER DEFLECTION (MILS)

	NORTHBOUND						SOUTHBOUND						
M-P	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	REMARKS
409.000													
410.000	0.93	0.92	0.87	0.70	5.19	104.	0.78	0.75	0.67	0.57	6.06	151.	
411.000													
412.000	0.93	0.92	0.87	0.70	5.19	104.	1.90	1.60	1.30	1.00	2.69	163.	
413.000													
414.000	0.90	0.86	0.78	0.64	5.34	146.	0.74	0.70	0.62	0.52	6.35	167.	
415.000													
416.000	0.96	0.95	0.72	0.57	5.05	100.	0.93	0.92	0.82	0.70	5.19	104.	
417.000													
418.000	1.00	0.90	0.80	0.70	4.86	182.	1.10	1.00	0.90	0.70	4.47	169.	
419.000													
420.000	0.78	0.73	0.64	0.53	6.06	171.	0.81	0.77	0.69	0.57	5.87	158.	
421.000													
422.000	0.70	0.68	0.57	0.48	6.67	148.	0.97	0.96	0.78	0.64	5.00	99.	
423.000													
424.000	0.81	0.76	0.67	0.56	5.87	168.	0.76	0.72	0.64	0.54	6.20	164.	
425.000	0.70	0.64	0.59	0.52	6.67	190.							
425.500													
426.000	0.69	0.67	0.60	0.52	6.75	150.	0.70	0.68	0.60	0.52	6.67	148.	
426.500													
427.000	0.71	0.66	0.60	0.53	6.59	180.	0.81	0.78	0.71	0.60	5.87	147.	
427.500													
428.000	0.82	0.77	0.70	0.61	5.80	166.	0.80	0.76	0.70	0.60	5.93	159.	
428.500													
429.000	0.94	0.89	0.72	0.61	5.14	150.	0.72	0.69	0.63	0.55	6.51	158.	
429.500													
430.000	0.82	0.77	0.70	0.61	5.80	166.	0.88	0.84	0.75	0.64	5.45	148.	
430.500													
431.000	0.94	0.90	0.83	0.71	5.14	140.	0.85	0.80	0.72	0.63	5.62	162.	
431.500													
432.000	0.90	0.84	0.75	0.66	5.34	165.	0.83	0.79	0.74	0.64	5.74	155.	
432.500													
433.000	0.81	0.76	0.69	0.60	5.87	168.	0.93	0.90	0.83	0.71	5.19	130.	
433.500													
434.000	0.80	0.79	0.69	0.60	5.93	122.	1.10	1.00	0.90	0.80	4.47	169.	
434.500													
435.000	0.86	0.82	0.76	0.65	5.56	151.	1.20	1.10	1.00	0.90	4.13	155.	
435.500													
436.000	1.10	1.00	0.90	0.80	4.47	169.	0.94	0.90	0.84	0.72	5.14	140.	
436.500													
437.000	0.86	0.81	0.72	0.60	5.56	161.	0.90	0.87	0.81	0.70	5.34	134.	
437.500													
438.000	0.83	0.76	0.69	0.60	5.74	182.	0.90	0.88	0.70	0.66	5.34	122.	
438.500													
439.000	0.86	0.83	0.76	0.66	5.56	140.	1.30	1.20	1.10	0.90	3.84	141.	
439.500													
441.000							1.10	1.00	0.90	0.80	4.47	169.	
442.000	0.99	0.96	0.85	0.70	4.91	122.	1.10	1.00	0.90	0.80	4.47	169.	
443.000													
444.000	0.80	0.74	0.63	0.53	5.93	178.	1.20	1.10	1.00	0.80	4.13	155.	

445.000												
446.000	1.10	1.00	0.90	0.70	4.47	169.	1.10	1.10	1.00	0.80	4.47	64.
447.000							1.50	1.40	1.20	1.00	3.36	107.
448.000	1.10	1.00	0.80	0.60	4.47	169.	1.20	1.10	1.00	0.80	4.13	155.
449.000							1.00	1.00	0.90	0.70	4.86	79.
450.000	0.88	0.85	0.70	0.58	5.45	137.	1.10	1.00	0.90	0.70	4.47	169.
451.000							1.00	1.00	0.90	0.80	4.86	79.
452.000	0.78	0.73	0.64	0.53	6.06	171.	0.92	0.87	0.78	0.70	5.24	153.
453.000							1.30	1.20	1.10	1.00	3.84	141.
454.000	0.77	0.74	0.63	0.51	6.13	152.	1.20	1.10	1.00	0.80	4.13	155.
455.000							1.20	1.10	1.00	0.90	4.13	155.
456.000	1.10	1.00	0.80	0.60	4.47	169.	1.20	1.10	1.00	0.90	4.13	155.
457.000							0.96	0.94	0.86	0.72	4.95	134.
458.000	0.74	0.66	0.61	0.51	6.35	200.	0.99	0.95	0.85	0.72	4.91	133.
459.000							0.92	0.88	0.80	0.68	5.24	143.
460.000	0.96	0.93	0.82	0.70	5.05	126.	1.10	1.00	0.90	0.70	4.47	169.
461.000							1.10	1.10	1.00	0.80	4.47	64.
462.000	1.10	1.00	0.90	0.80	4.47	169.	2.00	1.80	1.40	1.10	2.57	88.
463.000							1.30	1.30	1.10	0.90	3.84	50.
464.000	0.86	0.83	0.74	0.62	5.56	140.	1.30	1.20	1.10	0.90	3.84	141.
465.000							1.30	1.20	1.10	0.90	3.84	141.
466.000	1.00	1.00	0.80	0.70	4.86	79.						
467.000							1.00	1.00	0.80	0.70	4.86	79.
468.000	0.87	0.81	0.72	0.61	5.51	169.	1.00	0.90	0.80	0.70	4.86	182.
469.000							1.10	1.10	0.90	0.70	4.47	64.
470.000	0.83	0.81	0.74	0.63	5.74	132.	1.50	1.40	1.20	1.00	3.36	107.
471.000							1.60	1.50	1.40	1.10	3.17	89.
472.000	0.68	0.66	0.59	0.49	6.84	151.	1.10	1.00	0.90	0.80	4.47	169.
473.000							0.88	0.87	0.78	0.66	5.45	111.
474.000	0.91	0.87	0.77	0.64	5.29	144.	1.20	1.10	0.90	0.80	4.13	155.
475.000							1.00	1.00	0.90	0.80	4.86	79.
476.000	1.20	1.10	1.00	0.90	4.13	155.	1.20	1.10	1.00	0.80	4.13	155.
477.000							1.40	1.30	1.10	0.90	3.59	125.
478.000	0.95	0.90	0.81	0.67	5.09	149.	1.30	1.20	1.10	0.90	3.84	141.
479.000												
480.000	1.10	1.00	0.90	0.70	4.47	169.						
481.000												
482.000	0.94	0.89	0.78	0.64	5.14	150.						
483.000												
484.000	1.30	1.30	1.10	0.90	3.84	50.						
485.000	1.20	1.10	1.00	0.80	4.13	155.						
485.500												
486.000	1.20	1.10	1.00	0.80	4.13	155.						
486.500												
487.000	1.10	1.00	0.90	0.70	4.47	169.						
487.500												
488.000	1.20	1.10	1.00	0.80	4.13	155.						
488.500												
489.000	1.30	1.20	1.10	0.90	3.84	141.						
489.500												
490.000	0.90	0.88	0.76	0.64	5.34	122.						
490.500												
491.000	1.00	1.00	0.90	0.70	4.86	79.						
491.500												
492.000	0.90	0.87	0.77	0.66	5.34	134.						
492.500												
493.000	1.00	1.00	0.90	0.80	4.86	79.						
493.500												
494.000	1.10	1.00	0.90	0.80	4.47	169.						
494.500												
495.000	1.10	1.00	0.90	0.80	4.47	169.						
495.500												
496.000	1.00	1.00	0.90	0.70	4.86	79.						
496.500												

497.000	1.40	1.30	1.10	0.90	3.59	125.	1.50	1.40	1.30	1.10	3.36	107.		
497.500														
498.000	1.00	1.00	0.90	0.70	4.86	79.	0.99	0.97	0.89	0.77	4.91	109.		
498.500														
499.000	0.89	0.88	0.80	0.68	5.40	110.	1.20	1.10	1.00	0.90	4.13	155.		
499.500														

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